260473

best copy available

FLOOD INSURANCE STUDY

NEWARK PUBLIC LIBRARY

JAN 7 1981

U. S. GOVT. PUBS.
DEPOSITORY 376

TOWNSHIP OF COMMERCE, MICHIGAN

OAKLAND COUNTY

SEPTEMBER 16, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 260473

FEMI.209:

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
1.1	Purpose of Study	1
1.2	Authority and Acknowledgements	1
1.3	Coordination	1
2.0	AREA STUDIED	2
2.1	Scope of Study	2
2.2	Community Description	2
2.3	Principal Flood Problems	4
2.4	Flood Protection Measures	5
3.0	ENGINEERING METHODS	5
3.1	Hydrologic Analyses	5
3.2	Hydraulic Analyses	6
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	7
4.1	Flood Boundaries	9
4.2	Floodways	9
5.0	INSURANCE APPLICATION	10
5.1	Reach Determinations	13
5.2	Flood Hazard Factors	13
5.3	Flood Insurance Zones	13
5.4	Flood Insurance Rate Map Description	14

TABLE OF CONTENTS (Continued)

		Page
6.0	OTHER STUDIES	14
7.0	LOCATION OF DATA	14
8.0	REFERENCES AND BIBLIOGRAPHY	19

FIGURES

Figure 1 -	Vicinity Map	3
Figure 2 -	Floodway Schematic	10

TABLES

Table 1 -	Summary of Discharges	6
Table 2 -	Summary of Elevations	8
Table 3 -	Floodway Data	11
Table 4 -	Flood Insurance Zone Data	15

EXHIBITS

Exhibit 1 - Flood Profiles

Huron River	Panels	01P - 02P
Huron River West Branch	Panel	03P
Carus Lake and Pleasant Lake Channel	Panel	04P

Exhibit 2 - Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY

TOWNSHIP OF COMMERCE, OAKLAND COUNTY, MICHIGAN

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Commerce, Oakland County, Michigan, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the Township of Commerce to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Johnson & Anderson, Inc., for the Federal Insurance Administration, under Contract No. H-4535. This study was completed in June 1979.

1.3 Coordination

Streams to be studied by detailed or approximate methods were determined at initial coordination and time and cost meetings held on April 21, 1977, and November 4, 1977. Flood elevations, flood boundaries, and floodway delineations were coordinated with the Michigan Department of Natural Resources, the State Coordinating Agency, the Commerce Township Building Department, the Oakland County Drain Commission, and the Township of Commerce.

On January 23, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the FIA, the Study Contractor, and the Township of Commerce.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the Township of Commerce. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction through May 1984.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the FIA and the Township of Commerce.

The flooding sources studied by detailed methods within the corporate limits include; Lake Sherwood, Bass Lake, North Commerce Lake, South Commerce Lake, Lower Straits Lake, Fox Lake, Carroll Lake, Long Lake, Twin Suns Lake, Mud Lake, Reed Lake, Middle Straits Lake, and Union Lake. Also studied by detailed methods were the Huron River, between Commerce Lake and Fox Lake; the Huron River West Branch, between Commerce Lake and Fox Lake; and the Carus Lake and Pleasant Lake Channel, from a point 3,000 feet downstream of Haggerty Highway to Haggerty Highway.

Portions of the Huron River, Hayes Creek, Hawk Lake, the Channel from Hawk Lake to Stuart Lake, the Channel from Commerce Lake to Wolverine Lake, Carroll Lake Outlet, Proud Lake, Moss Lake, Sherwood Lake Outlet and Stuart Lake were studied by approximate methods.

2.2 Community Description

The Township of Commerce is located in southeast lower Michigan, approximately 20 miles northwest of the City of Detroit in the southwest part of Oakland County. The Township of Commerce is contiguous to the Township of White Lake on the north; the Township of West Bloomfield on the east; the Village of Wolverine Lake, the Cities of Walled Lake, Wixom, and Novi on the south; and the Township of Milford on the west. The population of Commerce was 9,607 in 1960, 14,556 in 1970, and approximately 19,000 in 1975 (References 1 and 2).

Temperatures in Commerce range from an average monthly high of 83 degrees Fahrenheit (F.) recorded in July, to an average monthly low of 16 degrees F. recorded in January. The average annual rainfall is 30 inches (Reference 3).

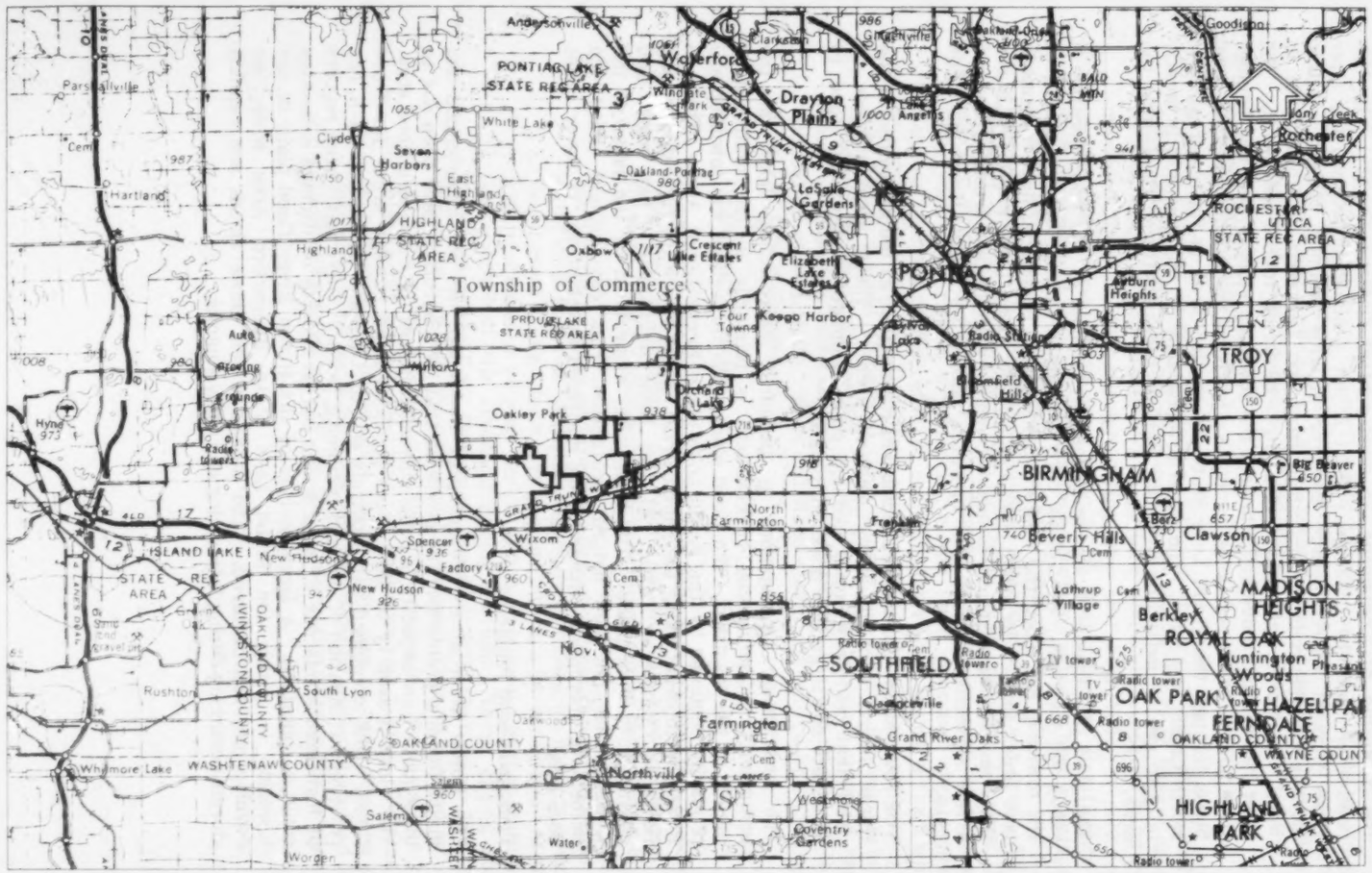


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

APPROXIMATE SCALE
4 0 4 8 12 MILES

VICINITY MAP

The Huron River begins at Big Lake in the Township of Springfield, north of the Township of Commerce, in west-central Oakland County. In this headwater area the drainage system is not well developed and the river flows through interconnected lakes or in wide swampy valleys. Within Commerce, the river moves south from the Township of White Lake to North Commerce Lake where it changes direction to the southwest. The river has a rapid movement through the township along gravel and boulder streambeds. The river flows through varied topography from deeply incised banks through the Proud Lake State Recreation Area to flatter areas near North Commerce Lake. The general topography of the township is mostly hilly to gently undulating with flat wetland areas scattered throughout the area.

The soils of Commerce are sandy loam with most of the lakes located in sandy soil districts. The rolling clay sections in the northeast quadrant of the township and along the western and southern boundaries have man-made lake areas formed by earth core dams. The flood plain along the Huron River and surrounding area is heavily wooded with lowland brush. There are a few agricultural areas still operating along the Huron River near Fox Lake.

The Township of Commerce, because of its location, at the headwater of the Huron River, contains many wetland areas. These great number of catchment and lake areas provide poor drainage features but tend to attenuate any large flow peaks in the area.

The residential development is primarily surrounding lakes in the community. Commercial development is primarily in the southeastern corner of the township. The flood plain areas throughout the township are primarily occupied by the Proud Lake State Recreational Area. There is little development along the Huron River except where the river divides and flows to Commerce Lake. At this point development has begun and continues to take place. The high relief along most of the lakes of the township has provided natural protection from development along the immediate shorelines, though some scattered development in lower areas does exist.

2.3 Principal Flood Problems

The Huron River at the Township of Commerce has not experienced any major flooding problems. The problems that have occurred have been due to inadequate flow capacity in some culverts, such as the Polvadera Road area. The close proximity of lake areas provides large storage areas for flood flows. This, combined with controls on Fox Lake and Commerce Lake, has provided attenuation of damage producing floods. There have been reports of high lake levels due to wind set-up but no records or damage estimates could be obtained. A large portion of the Huron River flood plain in the township is within the Proud Lake State Recreation Area where no development has occurred. The storms which cause floods are rainfall storms occurring during late spring and early summer.

2.4 Flood Protection Measures

The Huron River has no flood protection measures but, as previously stated, the lakes provide a natural storage area for flood flows. Controls on Commerce Lake, Fox Lake, Lower Straits Lake and Lake Sherwood are primarily used for recreation purposes.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

For the Huron River and the West Branch Huron River, flood-flow frequency data were based on statistical analysis of discharge records covering a 31-year period at the Commerce gaging station, a 28-year period at the Milford gaging station, a 28-year period at the New Haven gaging station and a 25-year period at the Hamburg gaging station. These gaging stations are operated by the U.S. Geological Survey (USGS) (Reference 4). The analysis generally followed the standard log-Pearson Type III method as outlined by the U.S. Water Resources Council (Reference 5). The discharge versus area relationship was adjusted by a regional skewness factor. The final flow was then determined based upon the relative size of each drainage area. The lake elevations for those lakes studied in detail were determined by the TR-20 program developed by the Soil Conservation Service (Reference 6).

For the Carus Lake and Pleasant Lake Channel, the flows were determined from a combination of two methods. First, the elevations and corresponding outflows for Pleasant Lake were calculated for the various frequency floods utilizing the same technique as for the other lakes in the township. Then hydrographs for the local areas downstream of Pleasant Lake were determined by the Brater Method (Reference 7), combined with the corresponding outflows from Pleasant Lake, and then channel routed through the study area by the SCS method (Reference 6). Due to large differences in peak times between the local areas and Pleasant Lake hydrographs, only average or "mean" outflows from Pleasant Lake were added to the local hydrographs in the determination of flood frequency flows in the channel between the two lakes.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
HURON RIVER					
At Fox Lake Outlet	48	145	205	240	300
At Hayes Creek	96	290	390	440	520
At Commerce Lake Inlet	218	705	990	1,145	1,440
CARUS LAKE AND PLEASANT LAKE CHANNEL					
At Haggerty Highway	2.07	18	30	32	41
At Welch Road	3.25	175	250	265	320

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross sections for the backwater analysis of the Huron River and Huron River West Branch and the respective lake outlets were field surveyed. For the Huron River West Branch, a total of 4 valley sections were field surveyed in the November 1977. The 16 valley sections and 6 bridge sections on the Huron River were also field surveyed in November 1977. For the Carus Lake and Pleasant Lake Channel, 3 valley sections were field surveyed in April 1979.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness factors (Mannings "n") for the Huron River, Huron River West Branch, and the Carus Lake and Pleasant Lake Channel were estimated using photographs (Reference 8), and field inspection in comparison with Open Channel Hydraulics by Chow (Reference 9). The range of "n" assuming summer conditions for the Huron River and Huron River West Branch ranged from 0.032 to 0.050 in the channel, and from 0.050 to 0.085 for the overbank. Values for Carus Lake and Pleasant Lake Channel ranged from 0.052 to 0.060 in the channel, and from 0.098 to 0.110 in the overbank.

The starting water-surface elevations for the Huron River and Huron River West Branch are the lake elevations for the corresponding frequency floods at Commerce Lake. Water-surface elevations for floods of the selected recurrence intervals for the streams studied were computed using the COE HEC-2 step-backwater computer program (Reference 10). A summary of elevations is presented in Table 2. Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). The lake elevations at Commerce for different frequency floods on the lakes studied by detailed methods were determined by the TR-20 program developed by the SCS utilizing monthly rainfall (Reference 6). For the Carroll Lake outlet, the starting water-surface elevations at a cross section 700 feet downstream from Grand Traverse East Road were determined by the slope-area method. Convergence runs were used to begin the backwater calculations for the Carus Lake and Pleasant Lake Channel.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

TABLE 2 - SUMMARY OF ELEVATIONS

LOCATION	ELEVATIONS (NGVD) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LAKE SHERWOOD	930.7	931.1	931.2	931.6
BASS LAKE	919.0	919.3	919.4	919.7
NORTH COMMERCE LAKE	909.0	909.6	909.9	910.5
SOUTH COMMERCE LAKE	909.0	909.6	909.9	910.5
LOWER STRAITS LAKE	931.8	932.2	932.3	932.7
FOX LAKE	930.9	931.1	931.2	931.3
CARROLL LAKE	923.4	924.3	925.0	926.0
LONG LAKE	934.6	935.3	935.6	936.2
TWIN SUNS LAKE	918.5	919.2	919.4	919.8
MUD LAKE	914.3	914.4	914.4	914.5
REED LAKE	915.9	916.9	917.3	918.2
MIDDLE STRAITS LAKE	932.0	932.4	932.6	932.9
UNION LAKE	927.7	928.0	928.1	928.5

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using USGS topographic maps at a scale of 1:24000, with 10-foot contour intervals (References 11 and 12).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. In Michigan, though, under Michigan Act 245, Public Acts of 1929, as amended by Act 167, Public Acts of 1968 (Reference 13), encroachment in the flood plain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the Bureau of Water Management, a floodway having no more than a 0.1-foot surcharge has been delineated for this study.

In general, the technique used to define the floodways in this report involved describing the sweep and extent of moving floodwater by applying engineering judgment and basic rules of hydraulics to the flooded outline maps. With this technique, the areas in the floodway fringe are areas of ponded water. Only areas with no conveyance (water-carrying ability) are included in the floodway fringe. Several areas along the Huron River in the

Township of Commerce were encroached to remove areas of shallow flooding from the floodway. The resulting increases in flood elevations were less than 0.1 foot. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 3). In lake areas, floodways were not computed because of the inappropriateness of floodway definition to lake flooding.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

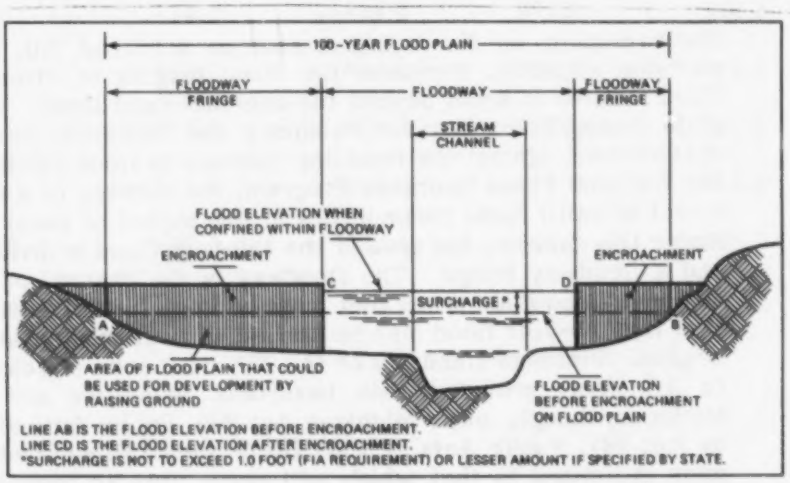

100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the Township of Commerce.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
HURON RIVER							
A	400	47	217	0.8	909.9	909.9	0.0
B	1075	52	246	0.7	910.0	909.9	0.1
C	1700	49	178	0.9	910.0	910.0	0.0
D	2346	64	102	3.5	912.8	912.8	0.0
E	2767	136	317	1.0	913.1	913.1	0.0
F	3152	59	126	2.5	913.3	913.2	0.1
G	3692	26	39	5.1	917.4	917.3	0.1
H	4292	25	35	5.7	926.8	926.8	0.0
I	4669	21	63	3.2	929.3	929.3	0.0
J	4870	128	591	0.3	929.5	929.5	0.0
K	5170	135	410	0.5	929.5	929.5	0.0
L	5795	28	81	2.5	929.5	929.5	0.0
M	6270	38	124	1.6	930.0	929.9	0.1
N	6397	74	514	0.4	931.2	931.2	0.0
O	6647	111	724	0.3	931.2	931.2	0.0
P	7097	56	207	1.0	931.2	931.2	0.0
Q	7847	504	1158	0.2	931.2	931.2	0.0
R	8407	37	97	2.1	931.2	931.2	0.0
HURON RIVER WEST BRANCH							
A	250	41	147	1.3	909.9	909.9	0.0
B	840	41	163	1.2	910.0	910.0	0.0
C	1090	50	146	1.3	910.1	910.0	0.1

[1]FEET ABOVE MOUTH

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOODWAY DATA

HURON RIVER - HURON RIVER WEST BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
CARUS LAKE AND PLEASANT LAKE CHANNEL							
A	3070	403	443	0.3	931.5	931.4	0.1
B	4070	561	729	0.2	931.7	931.6	0.1
C	5590	243	188	0.8	932.2	932.1	0.1

[1]FEET ABOVE WELCH ROAD

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOODWAY DATA

CARUS LAKE AND PLEASANT LAKE CHANNEL

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the Township of Commerce are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 4).

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the Township of Commerce was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.

Zones A1-A3: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.

Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 4, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Commerce is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

Floodway limits of the Carus Lake and Pleasant Lake Channel match those of the Township of Bloomfield Flood Insurance Study at the upstream community limit (Reference 14). The limits comply with FIA criteria. The Flood Insurance Study for the City of Novi, Michigan agrees exactly with this study (Reference 15).

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 16). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
HURON RIVER							
REACH 1	0005	–0.9	–0.3	0.6	010	A2	VARIES–SEE MAP
REACH 2	0005	–0.6	–0.1	0.2	005	A1	VARIES–SEE MAP
HURON RIVER WEST BRANCH							
REACH 1	0005	–0.9	–0.3	0.6	010	A2	VARIES–SEE MAP
CARUS LAKE AND PLEASANT LAKE CHANNEL							
REACH 1	0020	–0.5	–0.1	0.3	005	A1	VARIES–SEE MAP
LAKE SHERWOOD							
REACH 1	0005	–0.5	–0.1	0.3	005	A1	931

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOOD INSURANCE ZONE DATA

HURON RIVER - HURON RIVER WEST BRANCH - CARUS LAKE AND PLEASANT LAKE CHANNEL - LAKE SHERWOOD

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
LOWER STRAITS LAKE							
REACH 1	0005,0010	–0.5	–0.2	0.4	005	A1	932
FOX LAKE							
REACH 1	0005	–0.3	–0.1	0.1	005	A1	931
CARROLL LAKE							
REACH 1	0005	–1.6	–0.7	1.0	015	A3	925
LONG LAKE							
REACH 1	0010	–1.0	–0.3	0.6	010	A2	936
TWIN SUNS LAKE							
REACH 1	0015	–0.8	–0.2	0.4	010	A2	919
MUD LAKE							
REACH 1	0005,0015	–0.1	–0.0	0.1	005	A1	914

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOOD INSURANCE ZONE DATA

LOWER STRAITS LAKE - FOX LAKE -
CARROLL LAKE - LONG LAKE - TWIN SUNS LAKE - MUD LAKE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
REED LAKE							
REACH 1	0005	–1.4	–0.4	0.9	015	A3	917
MIDDLE STRAITS LAKE							
REACH 1	0010	–0.5	–0.1	0.3	005	A1	933
UNION LAKE							
REACH 1	0010	–0.4	–0.2	0.4	005	A1	928

[1] FLOOD INSURANCE RATE MAP PANEL
[2] WEIGHTED AVERAGE
[3] ROUNDED TO NEAREST FOOT

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOOD INSURANCE ZONE DATA

REED LAKE - MIDDLE STRAITS LAKE - UNION LAKE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
BASS LAKE							
REACH 1	0005	–0.4	–0.1	0.2	005	A1	919
NORTH COMMERCE LAKE							
REACH 1	0005	–0.9	–0.3	0.6	010	A2	910
SOUTH COMMERCE LAKE							
REACH 1	0005, 0015	–0.9	–0.3	0.6	010	A2	910

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOOD INSURANCE ZONE DATA

BASS LAKE - NORTH COMMERCE LAKE - SOUTH COMMERCE LAKE

8.0 REFERENCES AND BIBLIOGRAPHY

1. Oakland County Board of Commissioners, Statistical Profile of Oakland County, Michigan and Seven County Detroit Region, November 1974.

2. McGee, Robert, Commerce Township Clerk, Township of Commerce, Michigan, Personal Communication.

3. Michigan Department of Agriculture, Climate by Stations, 1971.

4. U.S. Geological Survey, Water Resources Data for Michigan, Water Year 1977.

5. U.S. Water Resources Council, Hydrology Committee, Bulletin No. 15, A Uniform Technique for Determining Flood Flow Frequencies, Washington, D.C., 1967.

6. U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 20, Computer Program for Project Formulation, Hydrology, May 1965.

7. Brater, E.F., and J.D. Sherril, Rainfall-Runoff Relations on Urban and Rural Areas, National Environmental Research Center, Columbus, Ohio.

8. Abrams Aerial Survey, Aerial Photographs, 1977.

9. Chow, V.T., Open Channel Hydraulics. New York: McGraw-Hill Book Company, Inc., 1959.

10. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, User's Manual, 1973.

11. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval 10 feet: Walled Lake Quadrangle, 1969, (photorevised) 1973.

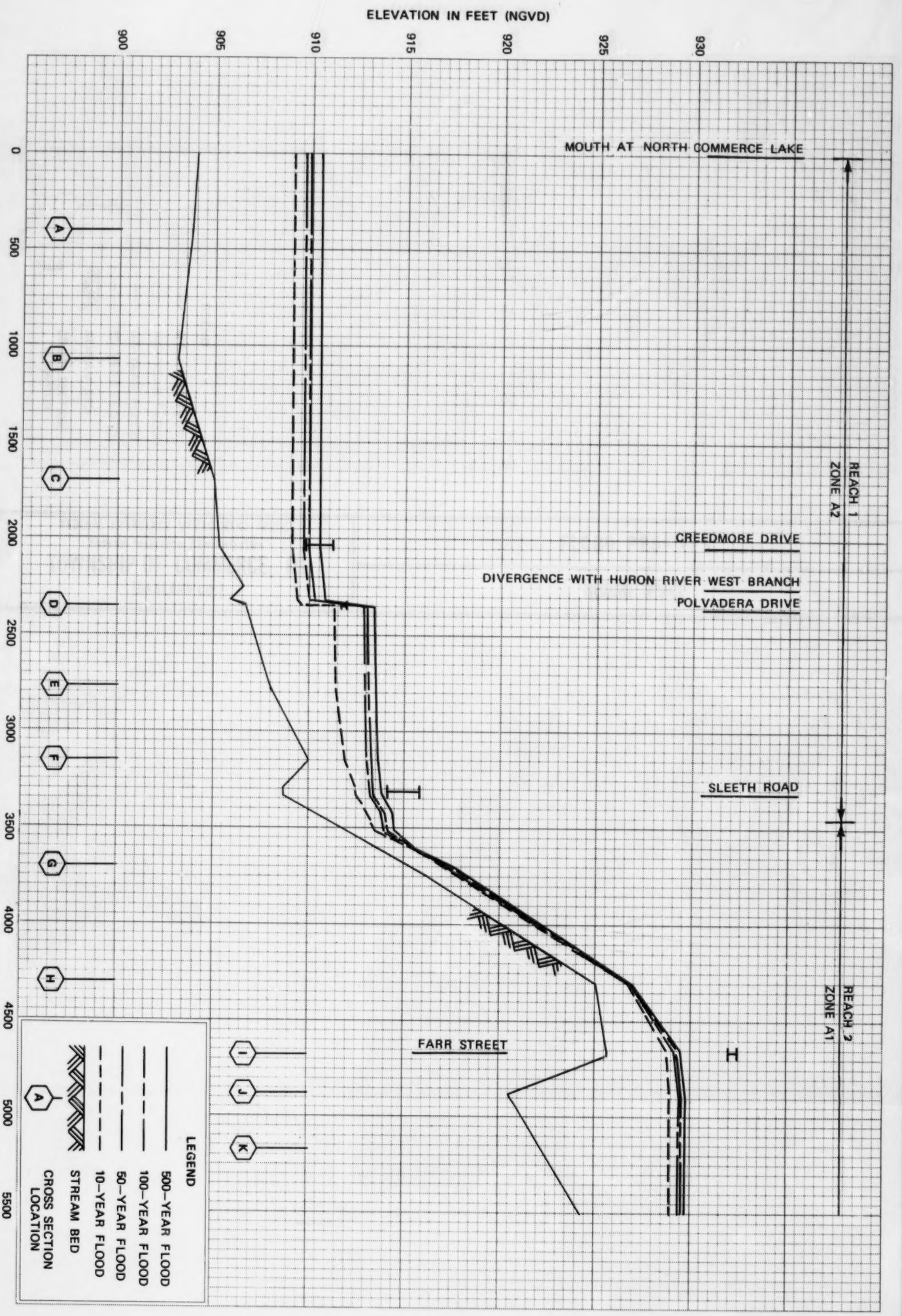
12. ———————, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval 10 feet: Milford Quadrangle, 1969, (photorevised) 1973.

13. State of Michigan, Flood Plain Control Act of 1968, Act 245, P.A. 1928 as amended by Act 167, P.A. 1968, Michigan Water Resources Commission, Lansing, Michigan, 1968.

14. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Township of West Bloomfield, Michigan, (in progress).

15. ———————, Flood Insurance Study, City of Novi, Michigan, April 1978.

16. ———————, Flood Hazard Boundary Map, Township of Commerce, Michigan, April 1977.



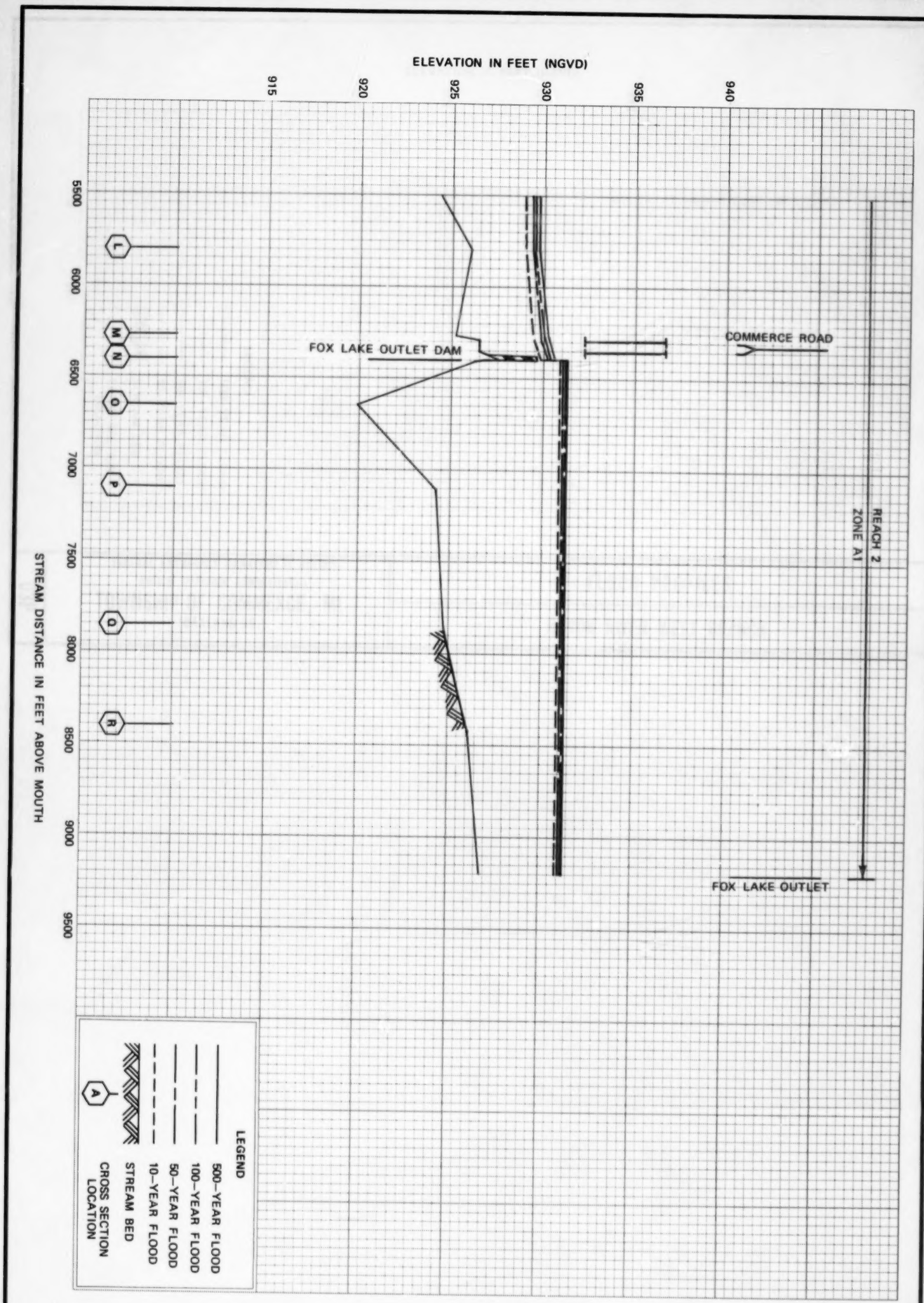
01P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOOD PROFILES

HURON RIVER

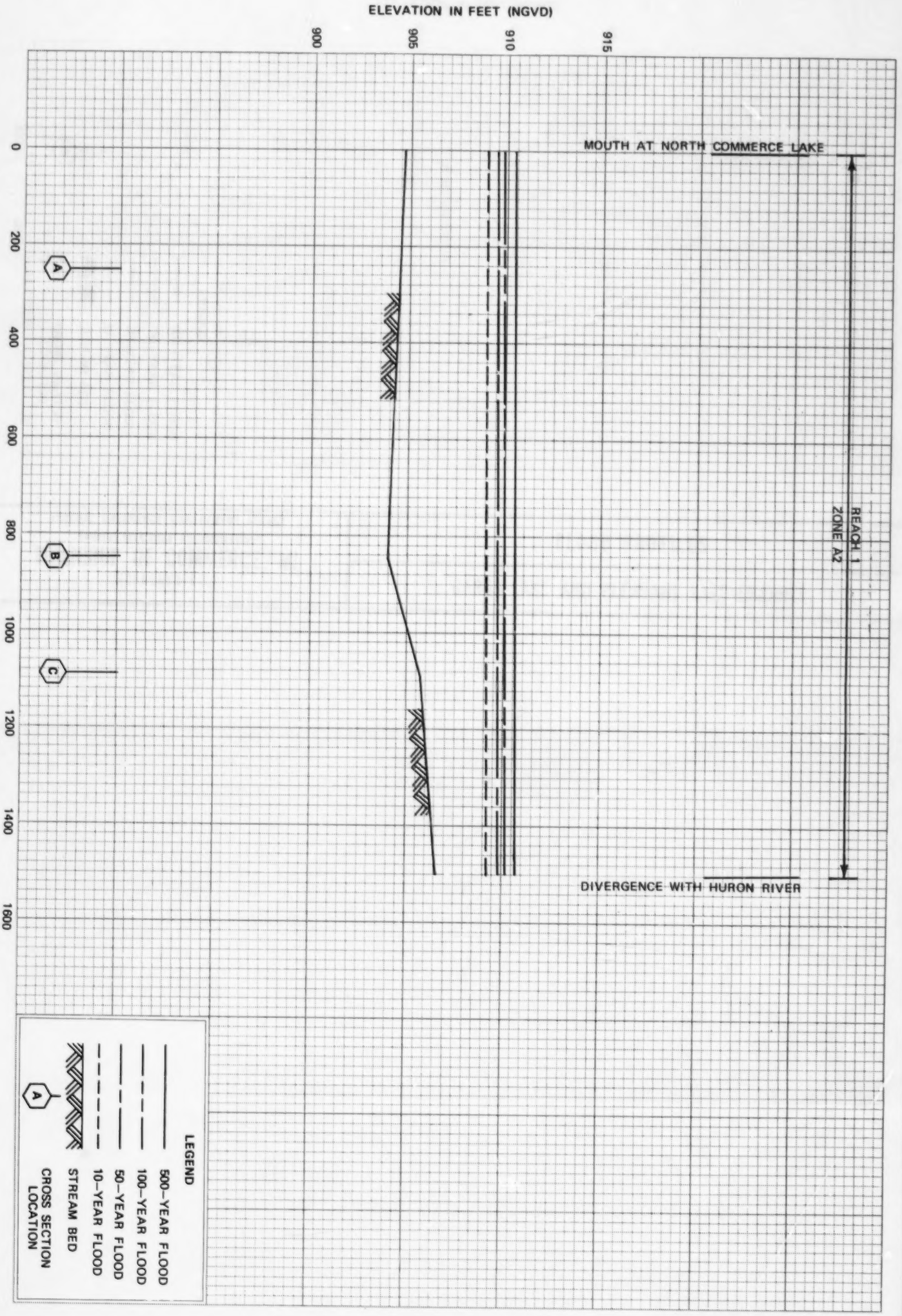


02P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOOD PROFILES

HURON RIVER



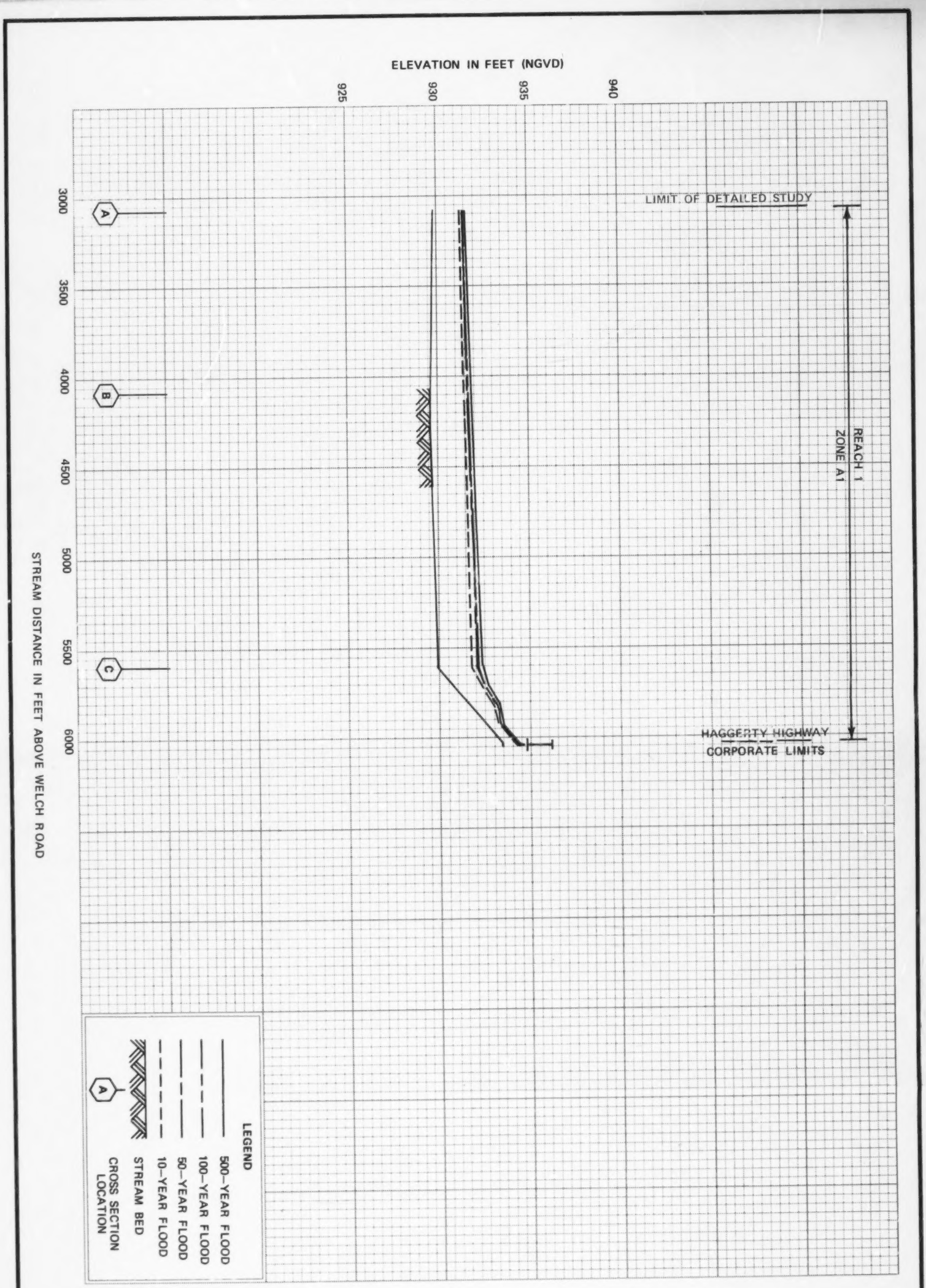
03P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOOD PROFILES

HURON RIVER WEST BRANCH



04P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWNSHIP OF COMMERCE, MI
(OAKLAND CO.)

FLOOD PROFILES

CARUS LAKE AND PLEASANT LAKE CHANNEL